

Dispersion Measurements

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The vast majority of manufactured ceramic components, films and coatings depend to some extent on the implementation of dispersion technology. That is, most ceramic manufacturing processes require that the starting material be finely dispersed in a liquid medium. This "slurry" then acts as a vehicle for shape forming in processes such as slip casting, tape casting, gel casting, spray drying and dip coating. In order for manufacturers to control the shape forming process in a reliable, cost-effective manner, they require knowledge of slurry properties and the means to measure those properties. In addition, a basic understanding of the chemistry and physics of dispersions is necessary to make property and performance predictions based on different slurry formulations.

We recently began joint studies with laboratories in Europe and Japan to lay the ground work for establishing international standards for dispersion measurements. Our present focus is on the isoelectric point (IEP), a key parameter characterizing the acid-base properties of ceramic slurries. Some recent results (see Figure 1) show the impact of water quality on the IEP of 1% alpha alumina as a function of pH. A recent parametric study on alumina examined the

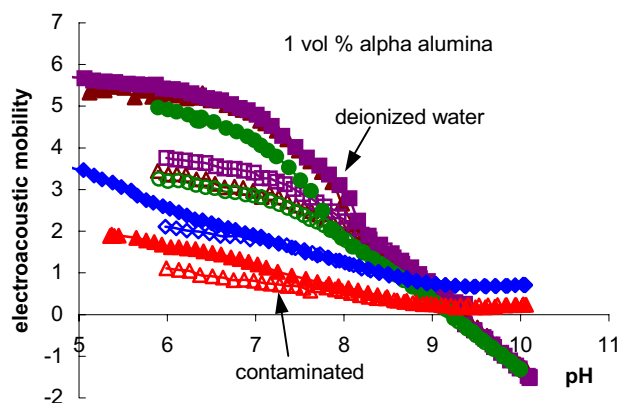


Figure 1. Effect of water quality on electroacoustic mobility and isoelectric point of alpha alumina suspensions.

The manufacture of advanced ceramics with ultrafine microstructures and enhanced performance requires starting materials that are extremely small in scale. To handle such fine particulates, complex mixtures (slurries) are created that include ceramic particles, processing additives and electrolytes in a liquid medium. The distribution of, and chemical interactions between, particulate components and additives in the slurry has a profound influence on the shape forming process. Dispersion measurements play a key role in developing reliable, robust manufacturing processes for advanced materials.

influence of a variety of sample and measurement related factors on the determination of the IEP, including speed of titration, sample preparation, conductivity, aging and particle volume fraction.

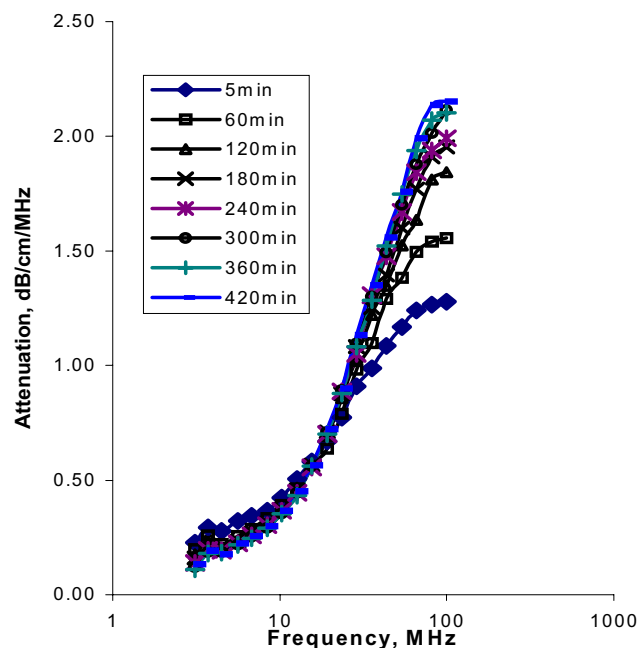


Figure 2. Acoustic attenuation spectra as a function of hydration time for a 2 vol % suspension of portland cement.

We are also developing methods for characterizing industrial suspensions. Such measurements are used to improve reliability and process control, and must cope with high solids concentrations and a complex mixture of components. We are developing methodologies to extract relevant acoustic signatures from amongst substantial noise and under complex and continually varying conditions. This requires that correlations be developed between measured signatures and suspension properties. Figure 2 shows the attenuation spectra as a function of time for a cement suspension undergoing hydration. The shifts in attenuation at specific frequencies is indicative of changes in particle size.

Contributors and Collaborators

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